Advanced signal processing

Academic Year: (2019 / 2020) **Review date: 27-03-2019**

Department assigned to the subject: Department of Signal and Communications Theory

Coordinating teacher: RAMÍREZ GIL, DAVID

Type: Electives ECTS Credits : 6.0

Year : 1 Semester : 1

STUDENTS ARE EXPECTED TO HAVE COMPLETED

The student should have basic knowledge of
- probability theory and statistics,
- linear algebra.

COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

- Acquisiton of knowledge and skills that provide with a background of creativity in the development and application of ideas, often within a research context.
- Ability to apply acquired knowledge and to solve problems under novel or almost novel situations or within broader (multidisciplinar) contexts related with Signal Processings
- Acquisition of skills for learning in an autonomous and continuated manner.
- Systematic comprehension of signal processing as a discipline of study and of the research skills and methods related with Signal Processing
- Ability to perform a critical analysis and synthesis of new and complex ideas.
- Ability to study and review scientific and technical documents about signal processing
- Ability to capture a deep view of the state-of-the-art in signal processing technology, as well as to forecast the near future in the field
- Ability to carry out an original work in a specific signal processing topic, including its presentation and discussion with other scientists
- Application of math, statistics and science to signal processing problems
- Ability to design and carry out experiments, as well as to analize and interpret their outcome
- Deep knowledge of advanced signal processing techniques such as linear filtering, adaptive filters, stochastic filtering in dynamical systems, and their application
- Ability to solve estimation and prediction problems in dynamic systems, including state space models and stochastic filters design.
- Deep understanding of adaptive algorithms, including steepest descend, least squares and non-linear versions. Ability to efficiently apply those algorithms in adaptive signal processing problems.

DESCRIPTION OF CONTENTS: PROGRAMME

+ Parameter Estimation
  - Bayesian Parameter Estimation
  - Risk-based Estimation
  - Nonrandom Parameter Estimation
  - Latent Variable Models
+ Hypothesis Testing and Signal Classification
  - Bayesian Hypothesis Testing, Neyman-Pearson, Composite Tests
  - Signal Classification
  - Asymptotic Performance
+ Signal Estimation
  - MMSE Estimation
  - Linear Estimation and Prediction
  - Adaptive Filtering
+ Model-Based Signal Processing
  - Markov Chains
  - Hidden Markov Models

LEARNING ACTIVITIES AND METHODOLOGY

The course is imparted in specific rooms and laboratories for the Master Program. It will include:
- Lectures for the presentation, development and analysis of the contents of the course.
- Practical sessions for the resolution of individual problems and practical projects in the laboratory.

- A project for each part of the course (Units 1-2: optimal filtering; Units 3-4: adaptive algorithms).
- Seminars for discussion with reduced groups of students

ASSESSMENT SYSTEM

The assessment of the students' performance will be done continuously over the semester:
- the instructor will supervise the resolution of problems by the students and
- the two projects of the course will also be graded based on the software developed, a report and an oral presentation (as requested by the instructor).

Convocatoria extraordinaria: it will consist on an oral exam of 30 minutes duration, where each student is tested on the material taught in this course. The final mark will depend solely on the result of this exam.

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

BASIC BIBLIOGRAPHY

- Murphy, K.P. Machine Leaning. A probabilistic perspective, MIT Press, 2012
- Poor, V An Introduction to Signal Detection and Estimation, Springer, 1994

ADDITIONAL BIBLIOGRAPHY

- Barber, D Bayesian Reasoning and Machine Learning, Cambridge University Press, 2012
- Bishop, C.M. Pattern Recognition and Machine Learning, Springer, 2006